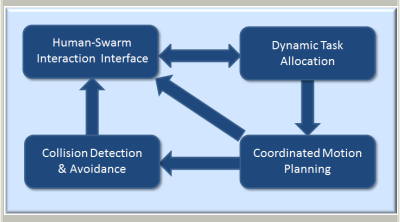
Spacecraft Swarm Coordination and Planning Tool, Phase I

Completed Technology Project (2016 - 2017)

Project Introduction

Fractionated spacecraft architectures to distribute mission performance from a single, monolithic satellite across large number of smaller spacecraft, for missions like close proximity inspection, sparse aperture arrays, robotic assembly, servicing, refueling, etc., can enable higher mission capability, reconfigurability and robustness. This distributed satellite architecture, with large numbers of agents, comes at the cost of extensive mission planning and computational complexity, and greater risk of collisions. As mission profiles scale up to hundreds of agents, there is an exponential increase in the system complexity needed to both plan and control satellite swarm activity and ensure it operates safely in the environment densely populated by other agents. Aurora Flight Sciences and the MIT Space Systems Lab propose a novel and comprehensive swarm coordination and planning tool that will allow ground-based operators to provide high level mission goals, and observe and re-direct swarms of spacecraft in LEO as the autonomy dynamically plans and executes complex multi-agent missions. The proposed effort combines elements of autonomous, dynamic, multi-vehicle coordination and path planning to meet mission objectives, facilitates close-proximity operations by integrating sensors and software for collision detection and avoidance, and allows high-level human-in-the-loop control of critical mission performance by implementing a Human-Swarm interface. Phase I focuses on developing and simulating discrete elements of the conceptual tool, leveraging powerful task allocation and path planning algorithms that Aurora has developed over the past several years, coupled with MIT's autonomous collision detection & avoidance and human swarm interfaces. In Phase II we will integrate the modules with a space mission analysis tool and demonstrate performance of key technologies on the SPHERES hardware testbed.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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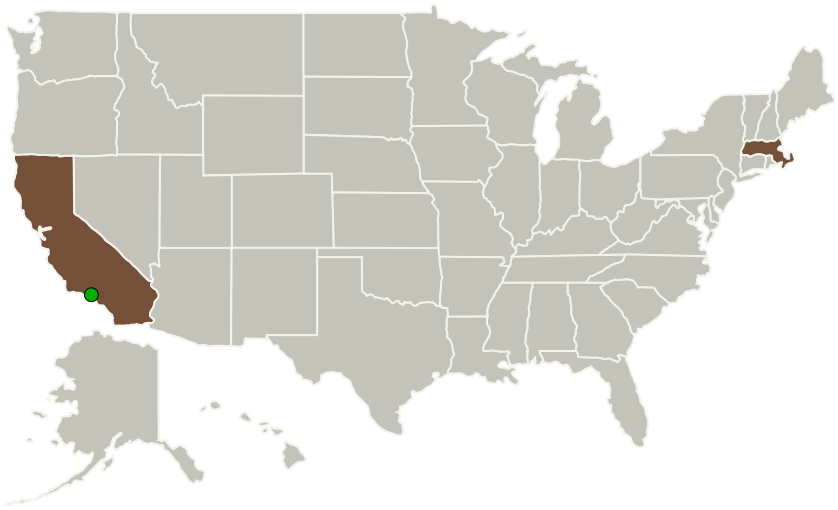
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
Massachusetts Institute of Technology(MIT)	Supporting Organization	Academia	Cambridge, Massachusetts

Primary U.S. Work Locations	
California	Massachusetts

Project Management

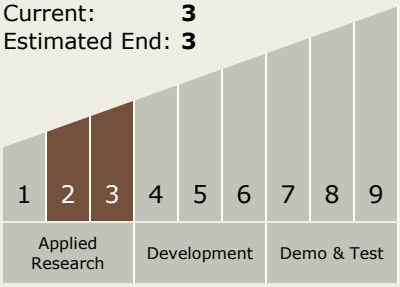
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Sachin Jain

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.2 Reasoning and Acting
    - TX10.2.6 Fault Response

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System

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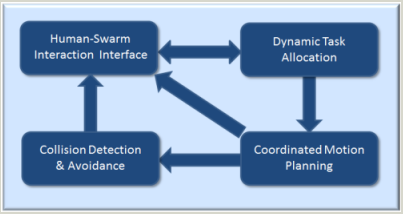
Images



Briefing Chart Image
Spacecraft Swarm Coordination and Planning Tool, Phase I
(https://techport.nasa.gov/image/130202)